AIR QUALITY HAMILTON 1970 - 1977

June 1978

Ministry of the Environment

Ontario

AIR QUALITY

HAMILTON

1970-1977

Technical Support Section
West Central Region

June, 1978

Contents

An Introduction to Air Monitoring in Hamilton

The air management program in the Province of Ontario is based on controlling man-made emissions to meet ambient air quality objectives, which in turn are derived on the basis of known effects on health, quality of life, or sensitive vegetation, whichever is most stringent. To this end, sources of pollution are identified, their emissions evaluated and appropriate measures are instituted at the sources aimed to achieve our air quality criteria. The monitoring of pollutants is then used to verify if the controls employed have been successful. On this basis, the placement of stations and instruments has generally been either downwind, in the predominent wind direction, or in the direction associated with unfavourable dispersion conditions of contamination from the major sources, so that "worst" concentrations are observed. If acceptable air quality is achieved in the vicinity of the worst sources, then conditions will be satisfactory in less polluted areas.

The monitoring of ambient air quality for all locations in a given area, such as the City of Hamilton, the detection of specific pollutants or the surveillance at any one moment of time of the various sources has not been our prime objective. Ontario's air monitoring program and budget exceed those of any province of Canada, and compare very favourably on a per capita basis with any state of the United States. While everyone will agree that it would be desirable to monitor all the contaminants in every place in each community, the taxpayers' money available for both manpower and equipment dictates that our monitors be employed on a priority basis in locations where specific pollutants may occur in concentrations exceeding our objectives.

Data observed in Hamilton indicate that the main problem is associated with particulate matter rather than gases. Although there has been considerable improvement in controlling the finer particulates, they often occur in amounts that exceed the objectives. There has been no improvement as far as dustfall is concerned. Dustfall levels have consistently been more than twice the criteria for large areas of the City.

Since 1970, the average change in concentration for the various forms of particulate has been as follows:

Total Suspended Particulates - 44% reduction
Coefficient of Haze - 37% reduction
Dustfall - 7% increase.

Air Pollution Summary
Hamilton - 1970-1977

Air Pollution Index (API)

During 1977, there were nine separate occasions when the API in Hamilton reached or exceeded 32. The maximum recorded index was 44. As in the past, these incidents usually occurred during the spring and fall months when inversion conditions are most prevalent. The winds during these occasions were usually very light and northeasterly.

The API has been shown to be a good indicator of general dispersion conditions in the City and the correlation with nearly all other monitored pollutants, other than ozone, is quite high. For Hamilton, the observations are made at the Barton and Sanford location (Woodland Park), halfway between the industrial northeast and the downtown area. Since the prevailing winds in Hamilton are southwesterly, it might appear that the monitoring of pollutants is effected upwind rather than downwind of the industrial area. The actual observations indicate however, that highest concentrations, particularly for the downtown area, are associated with poor dispersion of pollutants, which generally occurs with light northeasterly winds - often associated with lake breezes and inversion conditions over the City.

A summary of API data, since its introduction in 1970, is presented in Table 1. The decrease in occurrences of elevated values since 1971 is evident. The random variation of the number of elevated occurrences over 1972 to 1977 is probably related to varying weather conditions in each year.

Particulates

In the City of Hamilton, the major-problem pollutant has been particulate matter. Three basic methods, standard across North America, are used to quantify particulates; each relating to different size ranges of particles. Dust-fall is the heavy coarse material, which settles under its own weight with particles generally larger than 10 microns. Soiling index, or coefficient of haze (COH), is a measure of very fine matter, generally less than 10 microns in size. Total suspended particulates (TSP) cover a wide overlapping range from submicron to 50 microns and sometimes in excess of this. Generally, the finer particles (less than 5 microns) are considered most likely to affect health and are associated with emissions from industrial sources, whereas the coarser dust originates frequently from material stock-piles, road dust and wind erosion products.

Figure 1 is a graph illustrating the yearly trends of the three types of particulate along with the trend of estimated

yearly emissions from known industrial sources of particulates. The decrease in COH and TSP levels coincides with the decrease in estimated industrial emissions. Individual station trends for TSP are given in Tables 2a to 2c, and for COH, in Tables 3a and 3b.

At the moment, there are nine Hi-volume samplers in Hamilton. The steady improvement in TSP has reached the point that in 1977, two of the stations fell within the yearly objective of 60 ug/m^3 for the first time and four others were only marginally above it. The most heavily contaminated locations continue to be Barton/Sanford, North Park and Burlington/Leeds; the latter being in the heart of the industrial area. Despite the improvement, a serious TSP problem still exists. High maximums occurred for most of the stations in 1977, although high values are occurring with diminishing frequency.

The trend in COH levels mirrors that of TSP. Tables 3a and 3b show that in 1970 most of the stations were at or above the yearly objective, while in 1977, the levels at seven of nine stations are about half of the objective. The other two stations, Barton Street and North Park, have remained about constant over the eight year period, marginally in excess of the objective, although North Park's levels did worsen somewhat in 1977 from previous years. The daily criterion was exceeded often here - 58 times. This apparent increase may be due to an instrumentation problem, and is presently being investigated.

Unlike COH and TSP, dustfall levels (Tables 4a-4d) have not improved since 1970, and now pose the main pollution question for Hamilton. The levels have remained virtually constant throughout the 1970's at all locations. Figure 2 is a contour plot of 1977 dustfall levels. As dustfall results are very site specific (i.e. influenced mainly by sources immediately adjacent to the station), the plot is tenuous at best; however, it does show general conditions. Almost the entire City is encompassed within the isopleth representing the yearly criterion of 4.5 grams/square meter/30 days, and a good part of the lower City, in and around the industrial area, encounter levels double this value. It is apparent then, that fugitive dust sources, such as road dust, will have to be controlled in order for the objectives to be met.

Sulphur Dioxide

Table 5 summarizes sulphur dioxide data since 1970. The trend in the yearly averages at Barton/Sanford and North Park are illustrated in Figure 3. While at first glance it might appear that the two stations show opposing trends, on more careful examination, one can see that since 1972, the trends are the same, i.e., the concentrations have been gradually increasing. The increase may possibly be due to increased steel production. The large drop from 1970 to 1972 at Barton Street

....4

is explained by the regulations passed in 1970, which required the use of fuel oils with lower sulphur contents. As a result, the hourly and daily objectives have been exceeded only twice and once, respectively, at North Park in 1976, and not at all at Barton Street since 1971.

The 1977 levels at these two stations are marginally above and below the yearly objective, although well below the high value recorded at Barton Street in 1970. The Ontario yearly objective of .02 ppm, for this pollutant is based on effects to sensitive vegetation.

The major SO_2 sources in Hamilton are related to certain processes in the steel industry such as coke ovens, steel-making furnaces, etc. Other contributions are from domestic and industrial space heating.

In 1976, an SO_2 monitor was installed at the sewage treatment plant on Woodward Avenue. The levels in both years were quite low with all criteria being met.

In 1977, an instrument was installed in City Hall to monitor the conditions in the downtown area. With the exception of a single marginally excessive 24-hour average, probably due to local sources and adverse dispersion conditions, all criteria were met. The levels were similar to North Park's and slightly less than those at Barton Street.

Carbon Monoxide

Carbon monoxide has been monitored continuously since 1970 at Barton/Sanford. A summary of the data is given in Table 6. Figure 4 shows the downward trend in the yearly averages since 1970. The hourly and 8-hourly criteria (30 and 13 ppm) have not been exceeded since 1970. Carbon monoxide originates mainly from automotive sources although there is some contribution by industry as well. The reduction in CO levels is probably mainly due to automobile emission controls.

Hydrocarbons

Data for total hydrocarbons is shown in Table 6. The monitor has been located at Barton/Sanford since 1970. The instrument began measuring non-methane hydrocarbons in 1977, since our interest is mainly in the anthropogenic hydrocarbons. The new data are not comparable to previous data, and hence, they are not included in the table. The yearly averages are shown in Figure 4. Over the period of 1970-1976, no clear trend is apparent.

The bulk of hydrocarbon emissions are associated with industrial sources. There is also a substantial portion of hydrocarbons associated with automotive emissions.

Ozone

Ozone has been monitored at Barton/Sanford since 1974. The data are summarized in Table 6. An improper calibration technique used in 1976 resulted in the instrument reading high. As a result, the 1976 data was revised to its present status.

In recent years, southern Ontario has experienced periods of high ozone levels in the ambient air. The problem is fairly widespread which is shown by the fact that the hourly objective of 80 ppb has been exceeded frequently at Barton Street in Hamilton, in a rural location just outside Simcoe, and also at two new stations in St. Catharines and Kitchener. Other areas in southern Ontario have reported similar observations. The concentrations follow very definite annual and diurnal patterns. For the former, the levels peak in the warmer, sunnier summer months. The hourly criteria are usually exceeded only during the May to September period. The normal daily summer pattern occurs as follows: the levels start to build at about 8:00 a.m., peak at 2:00-4:00 p.m., and drop off during the night. These two patterns are directly related to the intensity of sunlight.

High levels of ozone are the result of weather conditions conducive to photo-chemical reactions in the troposphere of nitrogen oxides and hydrocarbons having anthropogenic sources. The photo-chemical reaction requires appreciable time. The reaction rate varies with the intensity of sunlight and it is probably affected by the temperature, humidity and the ratio of concentrations of the primary pollutants. Research has shown that if ozone control strategies are to be effective, the methodology to be employed depends on the HC/NO_x ratio.

Various studies have been carried out that show that high concentrations of ozone are being transported to southern Ontario from the United States under south and southwesterly winds.

Hydrogen Sulphide

Hydrogen sulphide has been monitored at North Park since 1974, and at Barton/Sanford since 1975. The data are summarized in Table 7. The hourly objective of 20 ppb is based on the perception of its odour which is associated with the smell of rotten eggs.

The two stations show quite different trends. Whereas North Park's levels decreased substantially from 1975 to 1977 both in yearly average and number of excessive hourly values, Barton/Sanford while showing a decrease from 1975 to 1976, increased again in 1977.

....6

The improvement at North Park is explained by more effective controls on the steel industries' coke oven emissions, and the reduction of hydrogen sulphide emissions from Cities Service Chemicals Limited a manufacturer of carbon black. The lack of improvement at Barton Street is surprising and is not readily explained.

Oxides of Nitrogen

Three types of nitrogen oxides have been measured at Barton/ Sanford and North Park since 1975. They are: nitrogen dioxide (NO_2), nitric oxide (NO), and nitrogen oxides (NO_x), which is the sum of NO and NO_2. The data are summarized in Table 8. Oxides of nitrogen are associated with high temperature combustion processes including automotive emissions.

Nitrogen dioxide levels have been increasing over the three years of data at both stations. The daily objective was exceeded a total of 11 times in 1977 - the first such occurrences. The hourly criterion was not exceeded. The levels are slightly higher at Barton Street.

Nitric oxide (NO) levels have remained steady for the three years of data. The levels at North Park are much higher than those at Barton Street.

Nitrogen oxides (NO_x) have also remained fairly constant over the three years, and again, the levels are higher at North Park than at Barton Street, although by a smaller factor than for NO.

Criteria have not been established for these latter two pollutants.

Sulphation

Data for sulphation rates are given in Tables 9a-9d. The results of 20 stations are presented. Figure 5 illustrates the trends in the yearly averages of 19 of the stations (the other station did not operate over the entire 1970-76 period). Over the 1970 to 1976 period, a decreasing trend is apparent. Due to an analytical error which occurred through part of 1977, data for that year are not presented. The 1977 values are presently being investigated for validity.

Figure 6 is a contour plot of the 1976 averages. Highest levels can be seen to occur in the industrial area.

During each year, a seasonal pattern occurs. The values are highest in the winter months at most stations, corresponding to the use of sulphur-bearing heating oils.

....7

Fluoridation

Fluoridation rates are given in Tables 10a and 10b. There have been 10 stations located in the City since 1970. The trend in the yearly averages are shown in Figure 5. The great decrease over the 1970-1974 period is quite apparent. Since 1974, the levels have remained virtually constant.

The large decrease is explained by the Steel Company of Canada's conversion during 1972-73 from a fluorspar fluxing agent to a non-fluoride fluxing agent in the open hearth furnaces.

....8

Summary

In summary, most pollutant levels in Hamilton have decreased since 1970. Sulphur dioxide, carbon monoxide, hydrogen sulphide and sulphation and fluoridation rates have all generally shown substantial decreases from the early 1970's followed by a steady state of acceptable concentrations in the past few years. Exceptions are the slight increase in sulphur dioxide levels since 1972 and the unexplained increase of hydrogen sulphide levels at Barton/Sanford in 1977.

Concentrations of hydrocarbons have shown no clear trend while oxides of nitrogen have either increased or held constant. This latter phenomenon is probably due to the increasing use of cleaner burning fuel oils and improved automotive emission control equipment which, while reducing hydrocarbon and carbon monoxide emissions, have increased emissions of oxides of nitrogen.

Ozone levels have shown a marginal decrease in recent years. The high levels observed in the summer months are probably mainly transported here from the United States.

As previously stated, particulate matter is the main pollution problem in Hamilton. While the levels of the finer matter have shown great improvement over the 1970's (although still above our objectives in many cases), dustfall levels have shown no such trend which indicates that a broadening of abatement measures must be considered if our goals are to be reached.

There continue to be problems which the public perceive to be offensive, problems of visible plumes of smoke and airborne particles and odours. The abatement staff continue to work towards elimination of these problems. The abatement programs with the major industries are progressing towards controlling the remaining sources of industrial emissions. While it cannot yet be conclusively documented, there is strong local and international evidence to show that the direction of abatement strategy must be broadened if the ambient air quality goals are to be met in Hamilton by the most practicable means. This re-direction involves consideration of fugitive dust sources, that to date have received little emphasis and include sources of dust such as unpaved areas, demolition and construction activity, road dust and traffic effects. There is a growing body of international agreement which holds that much of the airborne dust and dustfall in major cities stems from particles raised from roads by traffic and high winds.

Ontario Regulation 872/74
Regulation made under
The Environmental Protection Act, 1971

ONTARIO AMBIENT AIR QUALITY CRITERIA

POLLUTANT	MONTHLY	YEARLY
Fluoridation Rate ugF/100 cm^2/30 days	Apr. 15 - Oct. 15 40 Oct. 16 - Apr. 14 80	
Sulphation Rate mg SO_3/100 cm^2/day	0.70	
Dustfall gm/m^2/30 days	7.0	4.5

POLLUTANT	1-Hr.	8-Hr.	24-Hr.	Year
Sulphur Dioxide (SO_2) ppm	.25		.10	.02
Soiling Index (COH) COH's/1000 ft.			1.0	0.5
Carbon Monoxide (CO) ppm	30	13		
Ozone (O_3) ppm	.08			
Nitrogen Dioxide (NO_2) ppm	.20		.10	
Hydrocarbons (CH_x)	N O E S T A B L I S H E D C R I T E R I A			
Hydrogen Sulphide (H_2S) ppm	.02			
Suspended Particulate ug/m^3			120	60 Geo. Mean

AMBIENT AIR QUALITY MEASURING TECHNIQUES

A mixture of continuous and intermittent ambient air monitors are dispersed throughout the West Central Region. The following is a description of the principles and techniques involved in measuring the various pollutant concentrations.

GASEOUS POLLUTANTS BY CONTINUOUS ANALYSERS

Sulphur Dioxide (SO_2) and Hydrogen Sulphide (H_2S)

The instruments used are the Beckman 906A and Philips PW 9700. Both use the principle of a continuous coulometric titration. An air sample is drawn through a detection cell containing an anode, a cathode and a reference electrode immersed in a buffered solution of potassium bromide. The sample gas reacts with bromine to cause an electro-chemical imbalance in the cell which is proportional to the SO_2 or H_2S in the sample. For SO_2, a filter permits only SO_2 to enter the detection cell and for H_2S a different filter allows only H_2S and mercaptans to enter.

Ozone (O_3)

The instrument used is the Bendix 8002. It utilizes the principle of photometric detection of the chemiluminescence resulting from the flame-gas phase reaction of ethylene with ozone.

Nitrogen Oxides

The instrument used is the TECO 14D. It uses the principle of the chemiluminescent reaction of nitrogen oxides with ozone. Nitric oxide (NO) and total nitrogen oxides (NO_x) are measured directly while nitrogen dioxide (NO_2) is determined as the differential between the two.

Hydrocarbons

Hydrocarbons are measured by the Bendix 8201 and the Beckman 108A. The latter instrument only measures total hydrocarbons. The former has the capability of determining the difference between total hydrocarbons and the methane portion. Most methane is produced naturally and comprises a good part of the total concentration. The Bendix instruments are set to measure the difference (non-methane or "reactive" hydrocarbons) since we are primarily interested in controlling the man-made contaminants.

Both instruments utilize a flame ionization detector to ionize hydrocarbon molecules. The differential between the number of ions in this flame and a pure hydrogen flame is reported as an electrical signal. The Bendix instrument separates methane from the sample by gas chromatography.

For a number of reasons, the reliability of this method of measurement has been questioned. For one, flame ionization detectors (FID's) do not respond linearly to all hydrocarbons. Response factors can vary tremendously from one hydrocarbon to another. For another, different FID's have been known to respond differently to identical samples of air, probably due to the variation in the response of different FID's to different substances. As well, since non-methane hydrocarbons cannot be measured directly, more error is involved in their determination since their reported values are the differential between two measurements.

For these reasons, and the fact that the various substances have varying detrimental effects at different concentration levels, a standard or objective has not been formulated for the broad spectrum of "total hydrocarbons".

Carbon Monoxide (CO)

The instrument used is the Bendix 8501-5BA. It measures a differential of infra-red energy; carbon monoxide having a known absorption spectrum in the infra-red range.

PARTICULATES

There are three methods for the measurement of particulates. Each method measures different sized particulate matter. Dustfall containers measure the heavy matter, generally a size range of greater than 10 microns. The Hi-Vol sampler measures the total suspended matter, ranging in size from sub-micron to 50 microns (some dustfall is included). COH tape samplers substantially measure only the very fine matter: from sub-micron to less than 10 microns.

Dustfall

Dustfall is defined as that material which settles out under its own gravity. It is collected in elevated plastic containers during a 30 day exposure time. The material is separated from moisture, insects and large bodies and the residue is weighed. The results are expressed as a deposition rate of grams/ square metre/30 days.

Suspended Particulate

The device employed for this measurement is known as a high volume sampler (Hi-Vol). The instrument is sheltered and draws a known volume of air at a rate of about 1.5 cu.m./min through a preweighed filter for a period of 24 hours. The exposed filter is weighed and total air passage is determined.

The results are expressed in micrograms per cubic meter. In some locations these devices operate daily, but in most places, they run every sixth day. The actual schedule is the same throughout North America.

Soiling Index (COH)

COH tape samplers operate continuously and facilitate the determination of hourly or 2-hourly average soiling values. Screened air is drawn through a filter paper at a measured sampling rate of approximately .013 cu.m./min for units measuring hourly averages and half that for 2-hour instruments. At the conclusion of that time the optical density of the spot is measured by light transmittance and compared to that of the unexposed tape. Results are expressed in COH units per 1000 linear feet of air and hence hourly or 2-hourly values are directly comparable. A COH unit is defined as that quantity of light scattering solids on the filter which produces an optical density equivalent to 0.01.

AIR POLLUTION INDEX (API)

The air pollution index is reported for three cities in the West Central Region - Hamilton, Welland and Niagara Falls. The index is determined by combining running 24-hour average concentrations (measured at a single location in each city) of sulphur dioxide and particulate matter in an API equation. These two pollutants are known to act synergistically in causing detrimental human health effects. Due to logistic problems, particulate is observed as COH rather than TSP and since different locations have different COH-TSP relationships, different cities have different API equations. The reported values from city to city, however, are comparable as far as effects are concerned.

The equations used are as follows:

$$\text{Hamilton: API} = 2.50\,(13.90\ \text{COH} + 104.5\ SO_2)^{.80}$$

$$\text{Niagara Falls} = 1.47\,(15.74\ \text{COH} + 131.7\ SO_2)^{.92}$$

$$\text{Welland} = 1.15\,(16.84\ \text{COH} + 138.4\ SO_2)^{.97}$$

FLUORIDATION AND SULPHATION RATES

Fluoridation

The device used is known as a fluoridation "candle". A paper coated with calcium oxide (CaO) is wrapped around a cylinder and exposed to the atmosphere in a louvred housing for 30 days. The results are expressed as micrograms of fluoride per 100 square centimeters of exposed CaO per 30 days. The method is based on the following reaction:

$$CaO + 2HF \longrightarrow CaF_2 + H_2O$$

Sulphation

A "candle" exposed for 30 days, is used here as well. The amount of sulphur reacted with lead peroxide coated paper is reported as milligrams of sulphur trioxide per 100 square centimeters of exposed lead peroxide per day. Because of its oxidizing power, lead peroxide also converts mercaptans, hydrogen sulphide, sulphur dioxide and other sulphur compounds into sulphate. The method is based on the following reaction:

$$PbO_2 + SO_2 \longrightarrow PbSO_4$$

HAMILTON AIR MONITORING STATION LOCATIONS

HAMILTON AIR MONITORING STATION LOCATIONS

29001 - Hughson/Hunter - Located on the roof of the Hughson Health Building, 30 ft. above ground between Hughson and James Streets opposite the TH&B Railroad Station.

Instruments - Hi-Vol, COH, S Candle, F Candle and Dustfall jar.

29006 - Queenston - Located on the second hydro pole south of Queenston Road on Craigroysten Avenue, 15 ft. above ground.

Instruments - S. Candle and Dustfall jar

29007 - City Hall - Located on the roof of City Hall on Main Street West, 150 ft. above ground.

Instrument - Hi-Vol

29008 - North Park - Located at the end of North Park which is a dead end street off of Beach Blvd. The roof of the station is 12 ft. above ground.

Instruments - continuous SO_2, NO, NO_2, NO_x, H_2S, CH_x COH, Hi-Vol, S Candle, F Candle and Dustfall jar.

29009 - Kenilworth - Located on the roof of the Kenilworth Fire and Police Station at Roxborough Avenue, 20 ft. above ground.

Instruments - Hi-Vol, COH, S Candle and Dustfall jar

29010 - Burlington/Ottawa - Located on the third hydro pole north of Burlington Street on Ottawa Street, 15 ft. above ground.

Instruments - S Candle and Dustfall jar

29011 - Burlington/Leeds - Located on the hydro pole in front of Vitrex Ceramics at end of Leeds Avenue, 15 ft. above ground and on the roof of Vitrex Ceramics, 3 Leeds Avenue, 14 ft. above ground.

Instruments - Hi-Vol, S Candle and Dustfall jar

29012 - Burlington/Wellington - Located on the roof of Henninger Brewery, 22 ft. above ground.

Instruments - COH, Hi-Vol, S Candle, F Candle and Dustfall jar.

29015 - Merrick St. - Located on the upper landing of stairs to elevator room of the parking garage at the Hamilton Market, 30 ft. above ground.

Instrument - COH.

29017 - Chatham/Frid - Located on the roof of the Kiwi Shoe Polish Manufacturing Building, 25 ft. above ground.

Instruments - Hi-Vol, COH, S Candle, F Candle and Dustfall jar.

29019 - Mohawk/Warren Located on the roof of the building in the City Works Dept. yard on Mohawk Road, 18 ft. above ground.

Instruments - S Candle and Dustfall jar

29025 - Barton/Sanford - This station is a small brick building adjacent to Woodlands Park, the inlets are 12 ft. above ground.

Instruments - continuous SO_2, CO, CH_x, O_3, H_2S,NO, NO_2, NO_x, COH, Hi-Vol, S Candle, F Candle and Dustfall jar.

29026 - Woodward/Brampton - This station is a small brick building at the Hamilton Sewage Treatment Plant on Woodward Avenue, 12 ft. above ground, except for wind and temperature sensors which are 33 and 200 ft. above ground on meteorological tower.

Instruments - Wind, temperature, continuous SO_2, S Candle, F Candle and Dustfall jar.

29030 - Camden/Mohawk - Located on the second hydro pole north of Mohawk Road on Camden Street.

Instruments - S Candle and Dustfall jar

29031 - Sherman/Concession - Located on the third hydro pole west of Sherman on Concession Street at Henderson Hospital, 15 ft. above ground.

Instruments - S Candle and Dustfall jar

29036 - Roosevelt/Beach Road - Located on the first hydro pole south of Beach Road on Roosevelt, 15 ft. above ground.

Instruments - S Candle and Dustfall jar

29037 - Strathearn - Located on the ninth pole from the end of Strathearn Street, north of Burlington Street.

Instruments - S Candle and Dustfall jar

29044 - Wark/Beach Blvd. - Located on the pole in front of 312 Beach Blvd.

Instruments- S Candle and Dustfall jar

29046 - Highways Building, Burlington - Located on the roof of a small building between the Highways Building and O.P.P. Building, 10 ft. above ground.

Instruments - S Candle and Dustfall jar

29051 - Botanical Gardens - Located on the roof of the Administration Building in the Royal Botanical Gardens, 30 ft. above ground.

Instruments - S Candle and Dustfall jar

29054 - Beach/Conrad - Located on the roof of a shed on the west end of the Lawson Lumber Yard, on Beach Road, 10 ft. above ground.

Instrument - F Candle

29055 - LaSalle Park, Burlington - Located on second hydro pole on dock at end of LaSalle Blvd., 12 ft. above ground.

Instrument- S Candle and Dustfall jar

29058 - Q.E.W./Skyway - Located on the fourth lamp post from the old toll booth building on the Q.E.W., 15 ft. above ground.

Instrument F Candle

29059 - Burlington/Gage - Located on cement lamp post on Gage Avenue just south of Burlington Street, 15 ft. above ground.

Instrument - F Candle

29062 - Briarwood Vocational School - Located on hydro pole in front of school, 1842 King Street East, 12 ft. above ground.

Instrument - F Candle

29066 - Killarney Street - Located on east side on second hydro pole from Beach Blvd.

Instrument S Candle.

29067 - 450 Hughson Street North - Located on the roof of Bennetto Public School, 16 ft. above ground.

Instruments - COH, Hi-Vol, S Candle and Dustfall jar

29080 - City Hall - Located on the Mezzanine floor of City Hall on Main St. West, 30 ft. above ground.

Instrument - Continuous SO_2

TABLE 1

SUMMARY OF AIR POLLUTION INDEX DATA (API)

MEASURED AT STATION 29025 - BARTON/SANFORD, HAMILTON

API STARTED - APRIL, 1970

Year	No. of Occasions ≥32	≥50	Maximum Index	Date of Maximum
1970	15	1	56	Oct. 8
1971	23	0	48	Oct. 21
1972	6	0	41	Feb. 13
1973	2	0	34	Feb. 14
1974	11	0	44	Oct. 29
1975	10	0	36	Oct. 24
1976	7	0	40	Dec. 16
1977	9	0	44	Mar. 12

TABLE 2a

SUSPENDED PARTICULATE LEVELS

IN HAMILTON 1970 - 1977

MICROGRAMS PER CUBIC METER

Objectives: Daily - 120
1 Yr. - 60 (Geo. Mean)

Year	29001 - Hughson/Hunter			29007 - City Hall			29008 - North Park		
	Annual Geo. Mean	Max.	% of Values over 24 Hr. objective	Annual Geo. Mean	Max.	% of Values over 24 Hr. objective	Annual Geo. Mean	Max.	% of Values over 24 Hr. objective
1970	124	372	46	101	373	33	149	378	66
1971	120	317	49	127	1139	40	120	361	50
1972	118	348	45	109	399	36	134	382	53
1973	123	399	52	107	307	32	120	388	48
1974	97	281	32	86	227	25	120	359	54
1975	75	250	12	71	208	13	105	254	40
1976	76	324	14	65	277	16	102	272	37
1977	63	260	10	54	223	7	94	222	43

TABLE 2b

SUSPENDED PARTICULATE LEVELS

IN HAMILTON 1970 - 1977

MICROGRAMS PER CUBIC METER

Objectives: Daily - 120
1 Yr. - 60 (Geo. Mean)

Year	29009 - Kenilworth			29011 - Burlington/Leeds			29012 - Burlington/Wellington		
	Annual Geo. Mean	Max.	% of Values over 24 Hr. objective	Annual Geo. Mean	Max.	% of Values over 24 Hr. objective	Annual Geo. Mean	Max.	% of Values over 24 Hr. objective
1970	104	261	38				179	521	75
1971	90	171	32				159	888	71
1972	102	278	37				166	444	83
1973	102	275	34				170	429	75
1974	96	262	28	160	447	70	103	227	41
1975	76	156	15	117	295	44	90	225	30
1976	69	180	12	112	336	41	76	207	20
1977	61	171	7	95	285	23	70	179	7

TABLE 2c

SUSPENDED PARTICULATE LEVELS

IN HAMILTON 1970 - 1977

MICROGRAMS PER CUBIC METER

Objectives: Daily - 120
1 Yr. - 60 (Geo. Mean)

Year	29017 - Chatham/Frid			29025 - Barton/Sanford			29067 - 450 Hughson St. N.		
	Annual Geo. Mean	Max.	% of Values over 24 Hr. objective	Annual Geo. Mean	Max.	% of Values over 24 Hr. objective	Annual Geo. Mean	Max.	% of Values over 24 Hr. objective
1970	130	553	54	129	596	53			
1971	124	269	54	146	644	66			
1972	175	451	83	139	536	61			
1973	149	328	71	137	426	61			
1974	112	260	45	111	430	46	83	229	14
1975	87	238	24	99	890	35	63	210	7
1976	91	342	34	99	541	38	60	220	21
1977	72	261	15	96	527	35	59	156	7

TABLE 3a

SOILING INDEX (COH) LEVELS IN

HAMILTON 1970 - 1977

COH'S PER 1000 FT. OF LINEAR AIR

Objectives: 24 Hr. - 1.0
1 Yr. - 0.5

	29001 - Hughson/Hunter			29008 - North Park			29009 - Kenilworth			29012 - Burlington/Wellington		
	Annual Average	Max. 24-hr avg.	No. Times over 24-hr objective	Annual Average	Max. 24-hr avg.	No. Times over 24-hr objective	Annual Average	Max. 24-hr avg.	No. Times over 24-hr objective	Annual Average	Max. 24-hr. avg.	No. Times over 24-hr objective
1970	.64	1.9	18	.51	1.4	76	.38	1.5	14	.50	2.1	19
1971	.48	2.3	19	.51	1.5	29	.30	1.2	1	.25	1.8	3
1972	.48	1.6	15	.54	1.6	14	.35	1.1	1	.48	1.5	12
1973	.44	1.6	13	.54	1.7	34	.28	1.3	2	.43	1.3	2
1974	.33	1.4	5	.50	1.3	13	.31	1.4	4	.32	1.0	0
1975	.32	1.1	2	.43	1.4	11	.28	0.9	0	.20	0.8	0
1976	.28	1.0	0	.50	1.7	24	.25	1.2	1	.24	1.0	0
1977	.28	1.2	3	.63	2.0	58	.20	1.0	0	.26	0.9	0

TABLE 3b

SOILING INDEX (COH) LEVELS IN

HAMILTON 1970-1977

COH'S PER 1000 FT. OF LINEAR AIR

Objectives: 24 Hr. - 1.0
1 Yr. - 0.5

	29015 - Merrick/James			29017 - Chatham/Frid			29025 - Barton/Sanford			29067 - 450 Hughson St. N.		
	Annual Average	Max. 24-hr avg.	No. times over 24-hr objective	Annual Average	Max. 24-hr avg.	No. times over 24-hr objective	Annual Average	Max. 24-hr avg.	No. times over 24-hr objective	Annual Average	Max. 24-hr avg.	No. times over 24 hr objective
1970	.65	1.9	20	.50	1.9	16	.59	2.3	39			
1971	.51	1.8	12	.32	1.7	3	.67	2.5	51			
1972	.43	1.5	6	.44	1.7	8	.55	1.6	24			
1973	.38	1.3	10	.33	1.4	7	.48	1.5	14			
1974	.36	1.2	2	.29	0.9	0	.54	2.0	27	.28	1.1	1
1975	.26	0.9	0	.26	1.1	1	.56	1.8	30	.23	0.9	0
1976	.31	1.1	1	.30	1.4	2	.53	1.8	29	.25	1.2	1
1977	.26	1.1	1	.20	1.0	0	.54	2.1	24	.22	0.6	0

TABLE 4a

DUSTFALL - 1977

ALL VALUES IN GRAMS/SQ. METRE/30 DAYS

ONTARIO OBJECTIVE: 1 MONTH AVG - 7.0
1 YR. AVG - 4.5

Station	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average 1977	1976	1975
29001	Hughson/Hunter	5.7	7.0	13.4	11.6	10.1	5.5	7.7	5.9	9.2	5.4	8.1	9.2	8.2	8.4	8.8
29006	Queenston	5.3	7.6	17.8	8.5	8.9	15.3	6.2	15.5	-	9.5	-	5.9	10.1	9.1	7.7
29008	North Park	56.9	27.7	18.5	15.2	9.3	11.8	14.0	14.9	5.9	9.0	12.4	17.1	17.7	13.0	11.2
29009	Kenilworth	3.9	6.0	10.5	8.0	8.3	6.3	5.7	4.9	6.7	5.2	4.0	7.8	6.4	6.0	6.3
29010	Burlington/ Ottawa	3.3	12.2	24.5	18.9	12.7	10.4	16.5	13.7	17.5	13.8	15.4	16.5	14.7	13.7	15.8
29011	Burlington/ Leeds	4.7	17.7	23.4	19.8	19.0	16.1	5.7	10.3	18.6	13.8	13.4	13.1	14.6	14.7	17.2
29012	Burlington/ Wellington	10.2	6.5	16.1	11.7	11.1	9.8	-	10.6	12.4	8.2	8.3	17.1	12.0	8.4	10.5
29017	Chatham/ Frid	4.0	10.9	20.2	15.9	6.9	9.6	9.5	8.3	9.4	8.6	9.6	10.9	10.3	10.5	10.2
29019	Mohawk/Warren	3.4	5.1	7.9	6.2	4.8	4.8	18.3	5.1	6.6	3.4	3.8	3.8	6.1	5.6	4.9
29025	Barton/Sanford	6.3	9.7	14.8	14.4	14.1	14.2	14.3	11.7	13.4	7.9	9.4	7.6	11.5	10.2	8.8
29026	Woodward/ Brampton	3.2	5.4	7.1	5.6	5.1	4.5	5.3	5.5	4.9	5.5	4.4	3.2	5.0	6.0	6.3
29030	Camden/Mohawk	3.1	6.1	8.0	7.7	8.7	11.4	6.9	6.4	7.4	5.3	4.2	3.2	6.5	7.0	6.7
29031	Concession/ Upper Sherman	3.2	7.9	12.5	10.2	6.2	7.9	6.3	6.4	9.1	5.6	6.8	4.7	7.2	7.4	7.7

Underlined values are in excess of objectives

TABLE 4b

DUSTFALL - 1977

ALL VALUES IN GRAMS/SQ. METRE/30 DAYS

ONTARIO OBJECTIVE: 1 MONTH AVG - 7.0
1 YR. AVG - 4.5

Station	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average 1977	Average 1976	Average 1975
29036	Roosevelt/ Beach Rd.	2.1	10.6	16.7	16.6	10.0	12.7	12.9	12.5	13.5	11.4	8.3	8.2	11.3	12.3	11.6
29037	Strathearn	9.7	22.5	-	30.6	17.9	14.3	17.6	18.1	15.4	16.0	16.4	12.2	17.3	18.2	17.2
29044	Wark/Beach Blvd.	16.1	17.9	15.8	13.9	9.1	12.8	10.8	9.8	9.4	8.3	7.9	11.4	11.9	13.0	10.5
29046	Highway Bldg. Burl. Skyway	4.3	3.8	8.0	8.6	29.2	8.1	5.4	3.2	5.2	2.9	3.3	4.4	7.2	4.6	8.1
29051	Botanical Gardens Burlington	5.4	4.7	8.3	6.0	4.2	5.2	7.8	6.1	8.5	4.7	5.2	7.4	6.1	5.6	4.9
29055	LaSalle Park Burlington	1.5	1.8	2.9	2.5	3.1	3.9	5.0	-	4.1	2.7	2.7	2.3	3.0	2.8	2.1
29067	450 Hughson N.	10.5	4.9	10.9	-	8.6	5.1	7.4	4.3	9.8	5.1	3.8	13.1	7.6	8.4	7.7

Underlined values are in excess of objectives

TABLE 4c

DUSTFALL YEARLY AVERAGES

HAMILTON

GRAMS/SQ. METRE/30 DAYS

Station Number	1970	1971	1972	1973	1974	1975	1976	1977
29001	9.0	10.2	8.5	8.4	8.3	8.8	8.4	8.2
29006	5.9	6.3	7.6	6.9	7.1	7.8	9.0	9.1
29008	9.3	10.7	12.3	9.4	11.2	11.2	13.1	17.7
29009	6.3	5.0	7.4	7.0	7.1	6.3	5.9	6.4
29010	25.1	19.0	24.7	21.4	15.0	15.9	13.5	14.6
29011	16.4	14.5	15.6	16.3	16.0	17.2	14.8	14.6
29012	15.4	12.4	14.7	12.6	10.6	10.7	8.4	11.1
29017	6.9	5.9	7.2	8.7	10.7	10.1	10.7	10.3
29019	4.6	4.0	3.8	4.6	4.8	4.8	5.6	6.1
29025	8.6	7.3	9.7	10.1	8.4	8.8	10.1	11.5

TABLE 4d

DUSTFALL YEARLY AVERAGES (cont.)

HAMILTON

GRAMS/SQ. METRE/30 DAYS

Station Number	1970	1971	1972	1973	1974	1975	1976	1977
29026	5.4	5.5	4.1	5.0	6.0	6.2	6.1	5.0
29030	4.1	4.4	4.9	5.7	6.1	6.6	7.1	6.5
29031	8.5	7.0	8.6	8.1	8.5	7.8	7.4	7.2
29036	9.7	8.4	15.6	13.7	12.4	11.7	12.1	11.3
29037	8.6	10.8	13.9	18.1	17.8	17.2	18.0	17.3
29044	10.7	9.7	13.9	11.3	12.0	10.4	12.9	11.9
29046	5.4	4.2	4.9	4.8	5.9	7.9	4.5	7.2
29051	4.1	3.7	4.3	5.2	5.2	4.9	5.7	6.2
29055		3.8	3.6	3.9	6.8	2.2	2.9	3.0
29067					8.8	7.8	8.3	7.6
Average*	9.1	8.0	9.8	9.5	9.5	9.3	9.3	9.7

* Averages do not include 29067

TABLE 5

SUMMARY OF SULPHUR DIOXIDE DATA

1970 - 1977

HAMILTON

SO_2 Objectives: 1 Hr - .25
24 Hr - .10
1 Yr - .02

Units - Parts Per Million

Station	Year	Annual Average	Maximum 1-Hr	Maximum 24-Hr	No. times over objective 1-Hr	No. times over objective 24-Hr
29025 Barton/Sanford	1970	.033	.38	.23	9	11
	1971	.029	.31	.16	6	2
	1972	.016	.23	.10	0	0
	1973	.018	.22	.10	0	0
	1974	.022	.20	.09	0	0
	1975	.020	.21	.06	0	0
	1976	.021	.24	.09	0	0
	1977	.023	.17	.08	0	0
29008 North Park	1971	.013	.12	.07	0	0
	1972	.012	.18	.07	0	0
	1973	.008	.15	.08	0	0
	1974	.015	.16	.06	0	0
	1975	.013	.13	.06	0	0
	1976	.021	.30	.11	2	1
	1977	.017	.15	.08	0	0
29026 Woodward/ Brampton	1976	.012	.15	.04	0	0
	1977	.011	.18	.08	0	0
29080 City Hall	1977	.017	.16	.11	0	1

TABLE 6

SUMMARY OF CARBON MONOXIDE, TOTAL HYDROCARBONS AND OZONE DATA

1970 - 1977

STATION 29025 - BARTON/SANFORD, HAMILTON

YEAR	CO ppm					Total Hydrocarbons ppm		O_3 ppm		
	ANNUAL AVERAGE	MAXIMUM 1-HR	MAXIMUM 8-HR	No. times over objective 1-HR	No. times over objective 8-HR	ANNUAL AVERAGE	MAXIMUM 1-HR	ANNUAL AVERAGE	MAXIMUM 1-HR	No. times over objective 1-HR
1970	3.8	55	31	3	8	2.16	97			
1971	3.5	20	13	0	0	2.20	120			
1972	2.3	19	10	0	0	2.34	99			
1973	2.1	16	10	0	0	1.75	86			
1974	1.9	15	10	0	0	2.25	99	17.8	101	37
1975	1.4	12	7	0	0	2.19	80	22.7	192	317
1976	1.4	14	7	0	0	2.13*	61	18.0	128	95
1977	1.4	12	7	0	0	-	-	16.6	92	15

* - first six months only

TABLE 7

SUMMARY OF HYDROGEN SULPHIDE DATA

1974 - 1977

HAMILTON

H_2S objective: 1 Hr - 20

UNITS - Parts per Billion

Station	Year	Annual Average	Maximum 1-Hr	No. times over 1 Hr objective
29025 Barton/Sanford	1975	1.6	110	45
	1976	1.0	41	26
	1977	1.3	52	65
29008 North Park	1974	1.7	202	41
	1975	1.9	57	51
	1976	0.8	22	1
	1977	0.8	26	2

TABLE 8

SUMMARY OF NITROGEN OXIDES DATA

1975 - 1977

HAMILTON

NO_2 objectives: 1 HR - .20
24 HR - .10

UNITS - PARTS PER MILLION

Pollutant	Year	29025 - BARTON/SANFORD					29008 - NORTH PARK				
		Annual Average	Maximum		No. times over objective		Annual Average	Maximum		No. times over objective	
			1-HR	24-HR	1-HR	24-HR		1-HR	24-HR	1-HR	24-HR
NO_2	1975	.031	.13	.08	0	0	.034	.27	.09	7	0
	1976	.040	.18	.10	0	0	.038	.13	.09	0	0
	1977	.057	.18	.13	0	8	.045	.20	.14	0	3
NO_x	1975	.082	.66	.30	-	-	.109	.55	.30	-	-
	1976	.065	.91	.31	-	-	.119	.96	.40	-	-
	1977	.087	.63	.36	-	-	.117	.77	.40	-	-
NO	1975	.033	.64	.17	-	-	.073	.67	.23	-	-
	1976	.025	.81	.23	-	-	.081	.89	.34	-	-
	1977	.030	.55	.26	-	-	.073	.71	.34	-	-

TABLE 9a
SULPHATION RATE - 1976

ALL VALUES IN MILLIGRAMS SO_3/100 sq. cm./DAY

Ontario Objective: 1 month average - 0.70

Station	Location	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN 1976	MEAN 1975	MEAN 1974
29001	Hughson/Hunter	.60	.49	.50	.37	.53	.39	.30	.36	.40	.51	.37	.59	.45	.43	.43
29006	Queenston	.71	.41	.15	.28	.24	.20	.19	.28	.25	.03	.20	.53	.29	.32	.29
29008	North Park	1.58	1.31	.97	.69	.62	.59	.56	.90	.93	.95	.98	1.55	.97	.86	.86
29009	Kenilworth	.78	.59	.50	.40	.37	.30	.24	.39	.40	.60	.55	.69	.49	.44	.40
29010	Burlington/ Ottawa	.95	.88	1.09	.83	.79	.77	.53	1.01	1.08	1.12	.91	1.14	.93	.83	.93
29011	Burlington/ Leeds	.86	.71	.86	.62	.68	.67	.52	.72	.68	.84	.84	.61	.72	.67	.74
29012	Burlington/ Wellington	.55	.42	.48	.26	.30	.33	.18	.37	.40	.46	.38	.48	.38	.42	.39
29017	Chatham/Frid	.92	.66	.61	.43	.47	.29	.27	.28	.38	.57	.62	.66	.51	.45	.47
29019	Mohawk/Warren	.55	.52	.55	.36	.55	.42	.26	.36	.44	.53	.54	.54	.47	.41	.36
29025	Barton/ Sanford	.52	.59	.12	.39	.52	.42	.34	.39	-	.39	.42	.51	.42	.59	.54
29026	Woodward/ Brampton	.77	.66	.75	.45	.22	.23	.25	.37	.40	.47	.45	.68	.48	.40	.41
29030	Mohawk/Camden	.70	.46	.29	.27	.28	.26	.22	.41	.33	.21	.35	.54	.36	.36	.33

Underlined values are in excess of objective

TABLE 9b

SULPHATION RATE - 1976

ALL VALUES IN MILLIGRAMS SO_3/100 sq. cm./DAY

Ontario Objective: 1 month average - 0.70

Station	Location	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN 1976	MEAN 1975	MEAN 1974
29031	Concession/Sherman	.91	.63	.55	.39	.36	.34	.26	.41	.46	.51	.47	.62	.49	.46	.47
29036	Roosevelt/ Beach Rd.	1.03	.74	.64	.39	.40	.36	.38	.71	.50	.82	.76	.78	.63	.55	.55
29037	Strathearn	1.00	.89	.91	.55	.51	.39	.63	.83	.93	.85	.89	.76	.76	.75	.77
29044	Wark/Beach Rd.	1.07	.80	.19	.49	.27	.25	.34	.39	.41	.57	.81	1.02	.55	.49	.49
29046	Highways Bldg. Burlington Skyway	.56	.39	.18	.21	.12	.16	.11	.15	.19	.33	.37	.59	.28	.28	.27
29050	Hopkins Cres. Dundas	.50	.31	.31	.17	.12	.21	.10	.16	.20	.24	.19	.35	.24	.20	.16
29051	Botanical Gardens	1.02	.73	.65	.29	.31	.17	.11	.18	.23	.48	.52	.71	.45	.36	.32
29055	La Salle Park Burlington	.59	.46	.34	.19	.17	.21	.13	.31	.26	.38	.34	.63	.33	.37	.23
29060	Stoney Creek Municipal Office	.84	.58	.47	.27	.22	.14	.14	.18	.21	.44	.42	.62	.38	.33	.29
29067	450 Hughson N.	.61	.44	.36	.24	.31	.26	.15	.22	.21	.33	.38	.56	.34	.30	.31

Underlined values are in excess of objective

TABLE 9c

SULPHATION RATE YEARLY AVERAGES

HAMILTON

MILLIGRAMS SO_3/100 sq. cm/DAY

Station Number	1970	1971	1972	1973	1974	1975	1976
29001	.86	.66	.56	.55	.47	.43	.45
29006	.39	.38	.36	.30	.29	.32	.29
29008	.83	.74	.72	.69	.86	.86	.97
29009	.49	.48	.44	.37	.40	.44	.48
29010	1.46	1.37	1.11	1.01	.93	.90	.93
29011	1.04	.97	.83	.77	.74	.67	.72
29012	.44	.49	.45	.54	.39	.42	.38
29017	.72	.65	.59	.63	.47	.49	.51
29019	.48	.50	.45	.46	.36	.41	.47
29025	.98	.73	.70	.60	.54	.59	.42

TABLE 9d

SULPHATION RATE YEARLY AVERAGES (cont.)

HAMILTON

MILLIGRAMS SO_3/100 sq. cm/DAY

Station Number	1970	1971	1972	1973	1974	1975	1976
29026	.43	.44	.50	.42	.41	.43	.48
29030	.49	.46	.41	.32	.33	.36	.36
29031	.62	.60	.50	.45	.47	.50	.49
29036	.83	.78	.61	.49	.55	.55	.63
29037	1.14	1.13	.85	.81	.77	.75	.76
29044	.73	.61	.52	.50	.45	.49	.55
29046	.39	.38	.37	.27	.27	.28	.28
29051	.45	.38	.31	.34	.32	.36	.45
29055	.24	.20	.19	.23	.23	.37	.33
29067					.31	.30	.34
Average*	.68	.63	.55	.51	.49	.51	.52

* Averages do not include 29067

TABLE 10a

FLUORIDATION RATE - 1977

ALL VALUES IN MICROGRAMS/100 sq. cm/30 DAYS

Ontario Objectives: Apr 15 to Oct 15 - 40
Oct 16 to Apr 14 - 80

Station	Location	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN 1977	MEAN 1976	MEAN 1975
29001	Hughson/Hunter	29	30	46	39	51	29	33	21	42	30	66	32	37	29	57
29008	North Park	224	158	76	66	58	48	73	95	64	89	69	158	98	133	83
29012	Burlington/ Wellington	51	31	31	21	33	21	-	20	47	30	8	70	33	30	31
29017	Chatham/Frid	40	39	46	33	48	38	48	46	53	36	7	52	41	39	45
29025	Barton/Sanford	41	32	50	79	61	53	52	28	59	60	27	35	48	45	73
29026	Woodward/Brampton	73	69	69	35	48	39	45	38	43	57	12	42	48	63	47
29054	Conrad/Beach Rd.	73	63	79	76	98	62	45	62	69	136	19	47	69	65	74
29058	Q.E.W./Skyway	219	202	105	131	141	120	140	131	101	110	99	125	135	150	128
29059	Burlington/Gage	78	-	79	102	110	101	81	51	70	122	114	101	84	76	57
29062	Briarwood School King St. E.	43	81	-	74	64	53	69	54	57	69	65	61	63	48	46
29066	Killarney St.	161	115	80	71	49	38	43	57	47	74	134	98	81	80	57

Underlined values are in excess of objectives

TABLE 10b

FLUORIDATION RATE YEARLY AVERAGES

HAMILTON

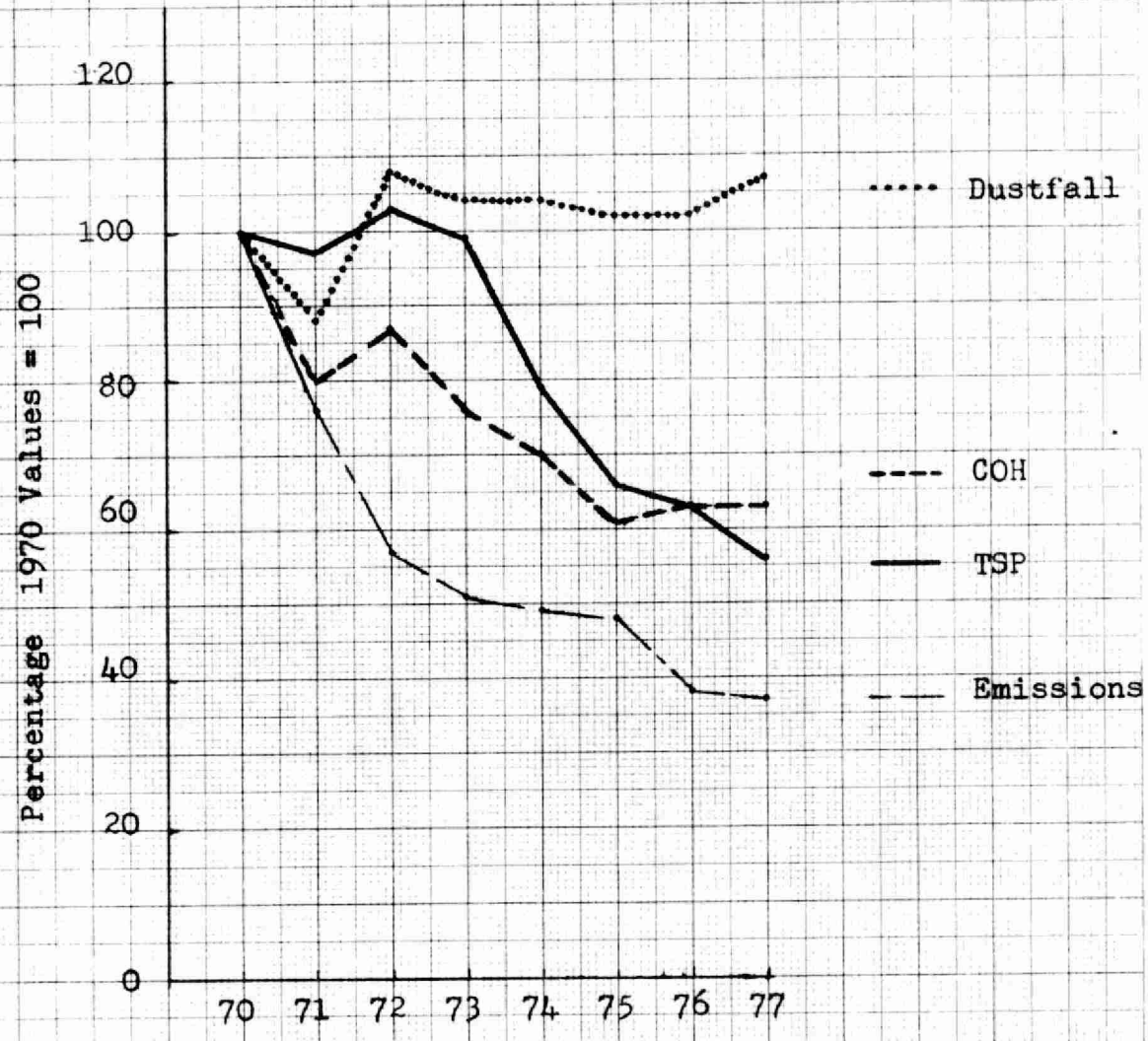
MICROGRAMS FLUORIDE/100 sq. cm/30 DAYS

Station Number	1970	1971	1972	1973	1974	1975	1976	1977
29001	102	81	71	56	35	57	29	37
29008	142	274	239	150	81	83	133	98
29012	50	61	70	72	33	31	30	33
29017	134	102	95	79	54	45	39	41
29025	139	94	107	88	76	73	45	48
29026	71	101	78	65	52	47	63	48
29054	151	199	100	82	61	74	65	69
29058	326	589	455	202	121	128	150	135
29059	239	171	155	161	62	57	76	84
29062	94	72	70	81	60	46	48	63
29066				72	63	57	80	81
Average*	145	174	144	104	64	64	68	66

*Averages do not include 29066

FIGURE 1

PARTICULATE TRENDS
Hamilton 1970-1977
1970 Values= 100%



TSP (7 stations)	131	127	135	130	104	86	83	73	ug/m^3
COH (8 stations)	.54	.43	.47	.41	.38	.33	.34	.34	COH's/1000ft
Dustfall(19 stns)	9.1	8.0	9.8	9.5	9.5	9.3	9.3	9.7	grams/metre^2/30 days
Emissions	63	48	36	32	31	30	24	23	10^6 lbs/year

FIG. 2 West Central Region - Hamilton FIG. 2

Dustfall (January-December, 1977)

Grams/Sq.Metre/30 Days

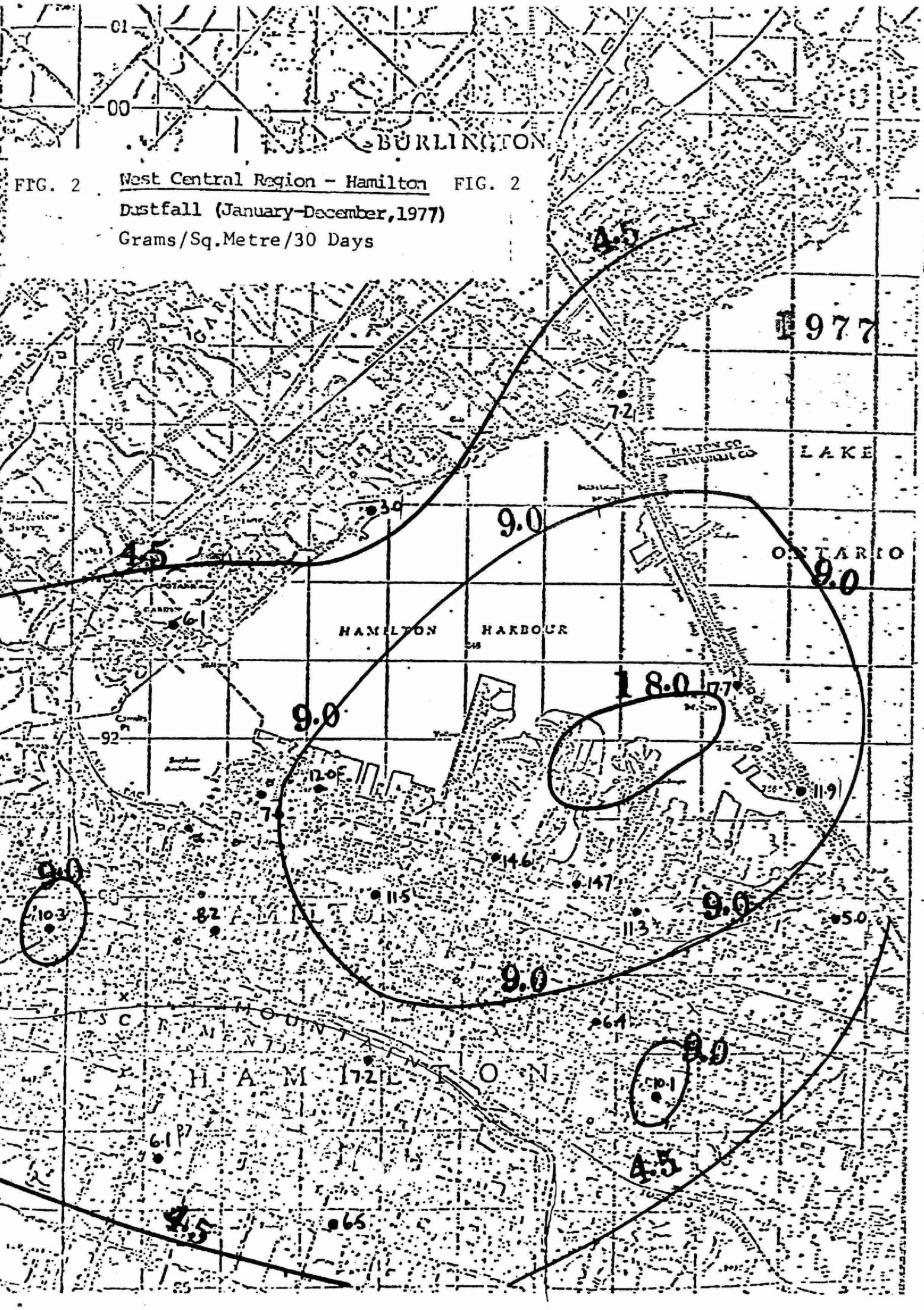
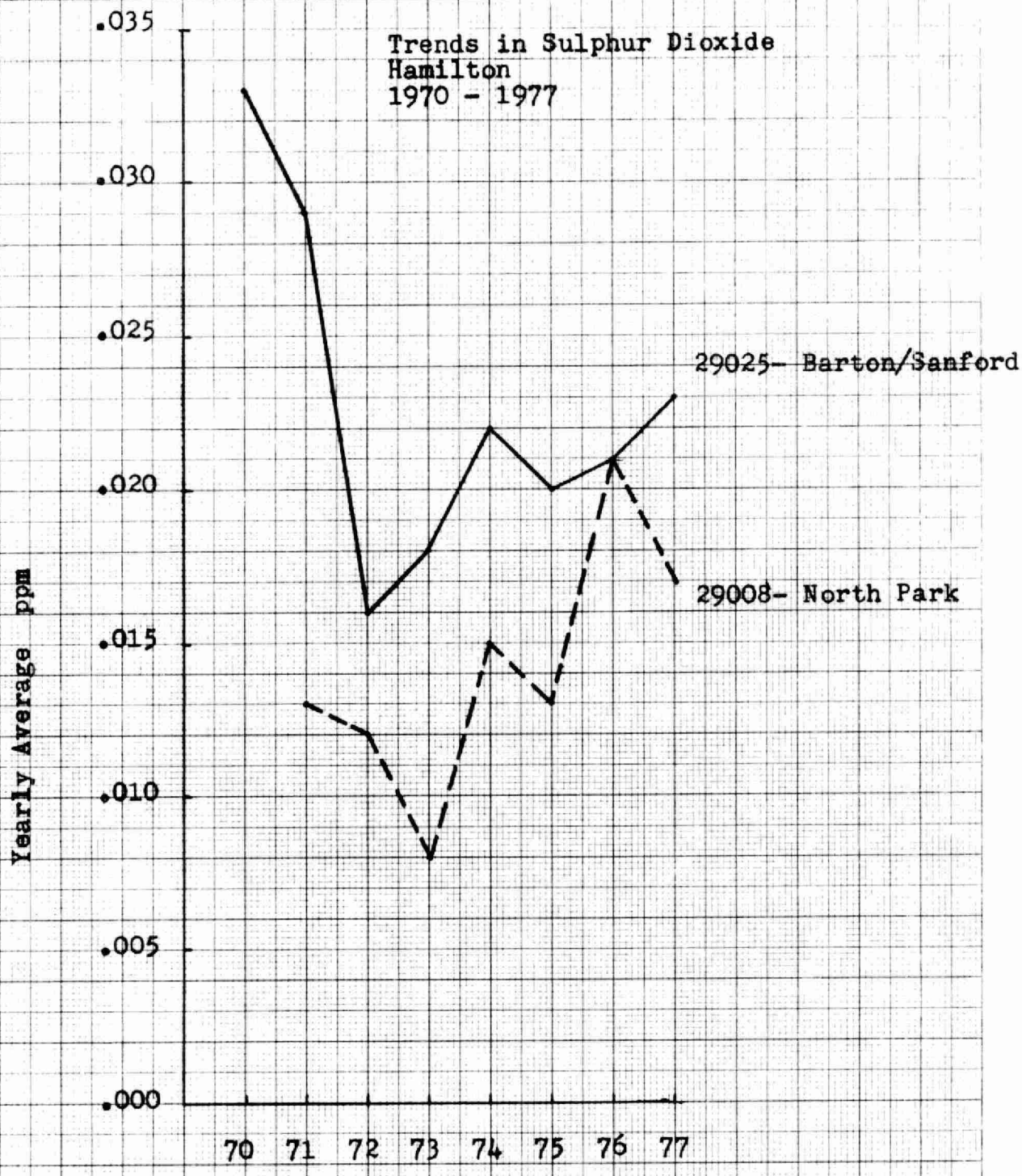


FIGURE 3

Trends in Sulphur Dioxide
Hamilton
1970 - 1977



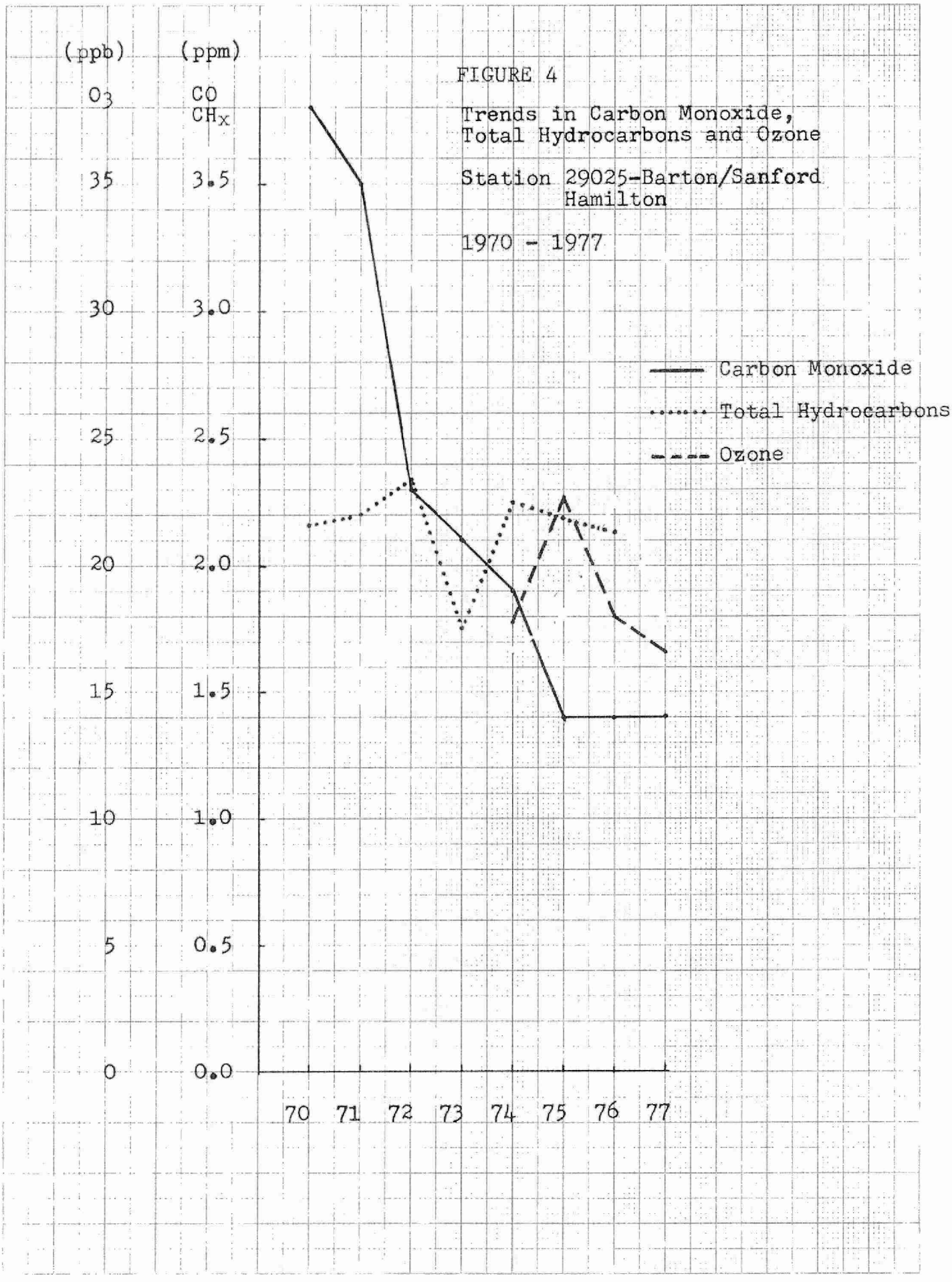


FIGURE 4

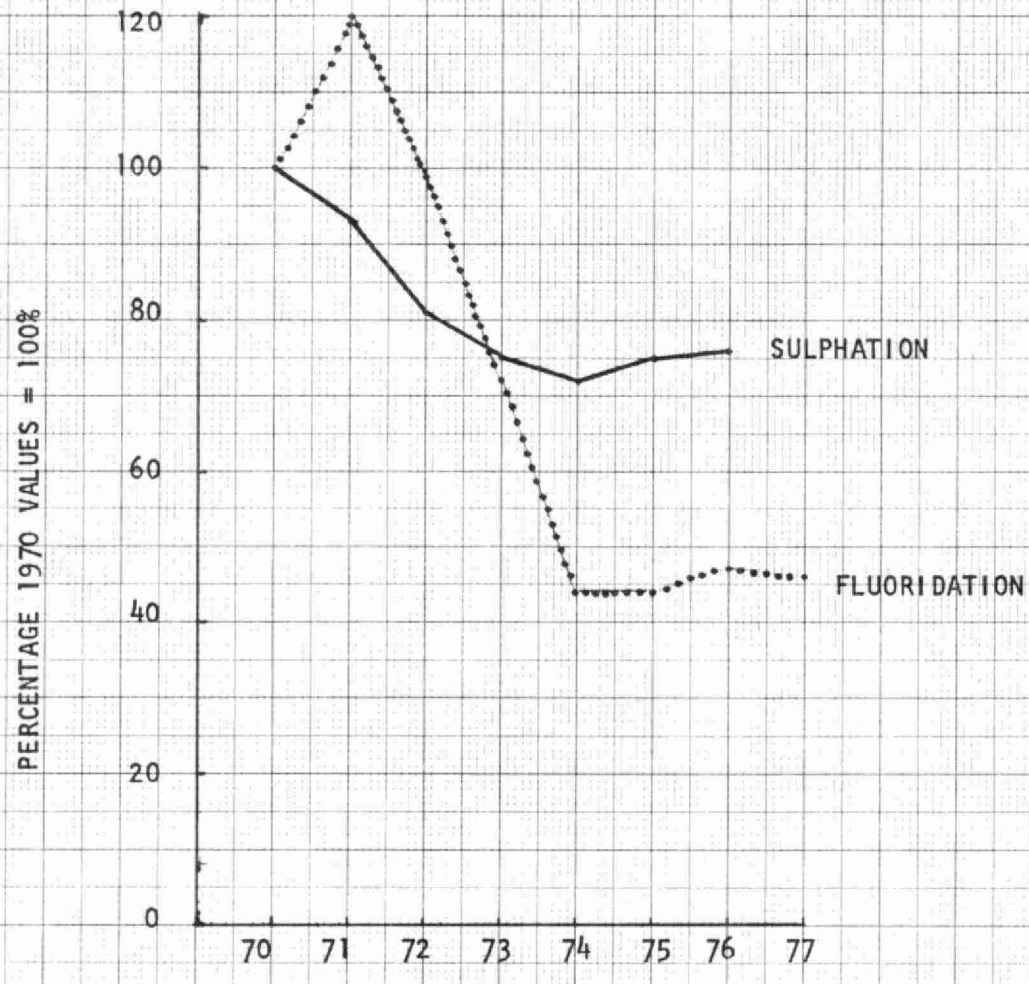
Trends in Carbon Monoxide, Total Hydrocarbons and Ozone

Station 29025-Barton/Sanford Hamilton

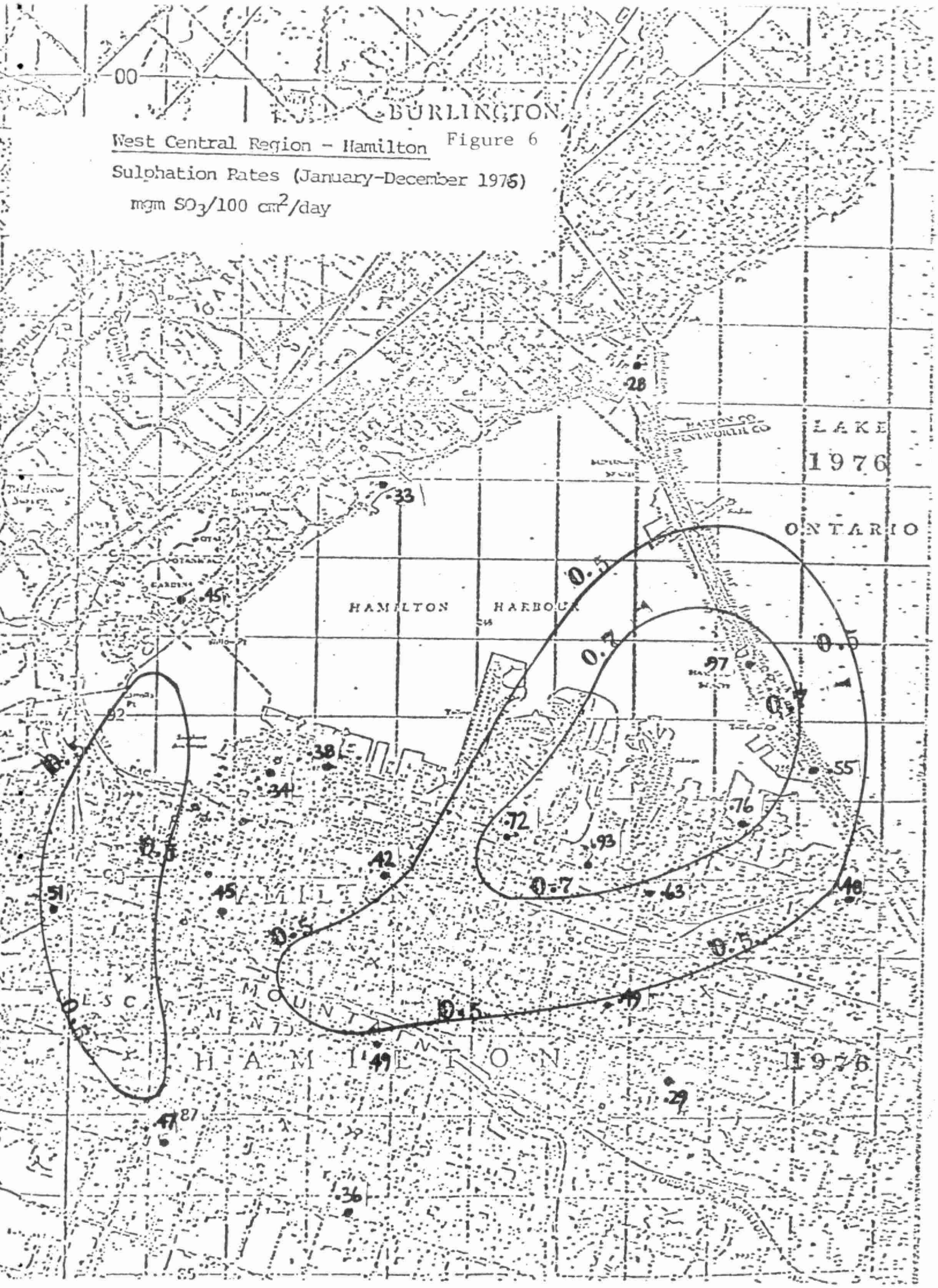
1970 - 1977

FIGURE 5

TRENDS IN SULPHATION AND FLUORIDATION RATES
HAMILTON 1970 - 1977
1970 VALUES = 100%



Sulphation (19 stations)		.68	.63	.55	.51	.49	.51	.52	$mgSO_3/100\ cm^2/day$
Fluoridation (10 stations)	145	174	144	104	64	64	68	66	$ugF/100\ cm^2/30\ days$



West Central Region - Hamilton Figure 6

Sulphation Rates (January-December 1976)

mgm $SO_3/100\ cm^2/day$